APPLICATION FOR LETTERS PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

FOR:

ENERGY ABSORBING PROPELLER SHAFT SYSTEM

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ENERGY ABSORBING PROPELLER SHAFT SYSTEM

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a propeller shaft for a vehicle, more particularly, to a vehicular propeller shaft capable of absorbing energy from an impact by being deformed laterally of a longitudinal axis of the vehicle.

[0002] Known propeller shaft arrangements for automotive vehicles are sometimes arranged such that the shaft will deform along a longitudinal axis thereof in the event of a load being placed on a front end of the shaft. A disadvantage with energy absorption via axial deformation is that the overall distortion of the propeller shaft under an axial load is somewhat unpredictable, thereby limiting what other automotive components can be placed in the vicinity of the propeller shaft.

[0003] There is, therefore, seen to be a need in the art for effectively isolating at least a portion of a propeller shaft from energy absorbing consequences of an axial load applied to the shaft.

SUMMARY OF THE INVENTION

[0004] Accordingly, a vehicular propeller shaft system having a longitudinal axis of rotation includes a first section extending along the longitudinal axis between a first end adapted to be positioned toward a vehicular engine and a second distal end, the first section including a weakened area having maximum susceptibility to buckling transversely to the longitudinal axis under a generally axial load. A second section having a first end coupled to the

second distal end of the first section and a second end adapted for coupling to a vehicle rear differential completes the propeller shaft system. Under the arrangement, when a predetermined generally axial load is applied to the first section, the first section buckles about the weakened area thereby absorbing substantially all of the axial load on the propeller shaft system.

BRIEF DESCRIPTION OF THE DRAWING

[0005] The objects and features of the invention will become apparent from a reading of a detailed description, taken in conjunction with the drawing, in which:

[0006] Figure 1 is a top perspective view of a vehicular propeller shaft system arranged in accordance with the principles of invention;

[0007] Figure 2 is a more detailed top perspective view of a first section of the propeller shaft system of Fig. 1;

[0008] Figures 3A-3C depict three alternative approaches to providing a weakened area of the first section of the propeller shaft system of the invention; and

[0009] Figure 4 is a graph depicting shaft load versus engine displacement in a typical front end collision for propeller shafts using and not using the principles of the invention.

DETAILED DESCRIPTION

[0010] With reference to Figs. 1 and 2, a two-piece propeller shaft system 100 includes an energy absorbing section 102 and a second rearward section 104. Section 102 includes a conventional bellows portion 116 which is coupled to a power transfer unit 108. Section 104 is coupled to a distal end of section 102 and at a second end to a rear differential 114.

[0011] Shaft system 100 is supported along its longitudinal axis by a front mounting bracket 110 and a center mounting bracket 112 as shown in the top view of Fig. 1.

[0012] As seen from Fig. 2, a swage or necked-down region 200 of shaft section 102 is placed intermediate the section's two ends and provides for a weakened area of shaft section 102 which is more susceptible to bending or buckling about area 200 than any other portion along the axial length of section 102.

[0013] As shown in phantom outline form in Fig. 2, when an axial load is applied to the propeller shaft from the left as viewed in Fig. 2, section 102 absorbs the energy of this load by buckling about weakened area 200 as shown. With this approach, substantially all of the energy is absorbed in the front section 102 and section 104 is thereby isolated from the effects of the axial load. For this reason, section 104 will remain substantially stationary even under an axial load at the front end of the propeller shaft system and can therefore be placed in proximity to vehicular components such as a fuel tank 106.

[0014] Weakened area 200 of shaft section 102 can be provided by a number of alternative approaches. Figs. 3A, 3B and 3C set forth three additional alternative embodiments to providing for a weakened area in propeller shaft section 102.

[0015] In Fig. 3A, a necked-down region 200A provides a weakened area for shaft section 102A. In Fig. B, a plurality of perforations 300 provide for a weakened section 200B of shaft 102B thereby providing for the buckling of the section in a direction transverse to the longitudinal axis of the propeller shaft.

[0016] Finally, in Fig. 3C, the weakened area 200C can be formed by necking out the inner wall of propeller shaft 102C. Other alternatives will become apparent to those of ordinary skill in the art.

[0017] Fig. 4 sets forth a graph with axial load represented by the vertical axis 400 and engine displacement represented by the horizontal axis 401. As shown in the dashed line 404, when a propeller shaft has no arrangement provided for energy absorption, the load will continually increase as the axial load exerted by engine displacement is placed upon the shaft system. When the principles of the instant invention are applied to a propeller shaft system, thereby providing for transverse bucking of the front section of the propeller shaft system, the load versus engine displacement is as shown in curve 402 of the graph of Fig. 4.

[0018] The invention has been described with reference to a detailed description for the sake of example only. The scope and spirit of the invention are to be determined from the appropriately interpreted appended claims.